Claims

We claim:

1. A method for making a cellulosic web, comprising:

(a) depositing an aqueous suspension of papermaking fibers between an endless first fabric and an endless second fabric to form a wet web wherein the wet web is sandwiched between the first and second fabrics;

(b) dewatering the wet web to a consistency of about 30 percent or greater using a noncompressive dewatering device that is adapted to cause a pressurized fluid at about 5 pounds per square inch gauge or greater to flow substantially through the web due to an integral seal formed with the wet web;

(c) pressing the dewatered wet web against the surface of a heated drying cylinder to at least partially dry the dewatered wet web; and,

(d) drying the dewatered wet web to a final dryness.

2. A method for making a cellulosic web, comprising:

(a) depositing an aqueous suspension of papermaking fibers between an endless first fabric and an endless second fabric to form a wet web wherein the wet web is sandwiched between the first and second fabrics;

(b) dewatering the wet web to a consistency of about 10 to about 30 percent;

(c) supplementally dewatering the wet web to a consistency of about 30 to about 40 percent using an air press that is adapted to cause a pressurized fluid at about 5 pounds per square inch gauge or greater to flow substantially through the wet web due to an integral seal formed between an air plenum and a collection device to give the dewatered wet web a bulk of about 8 cubic centimeter per gram or greater;

(d) pressing the dewatered wet web against the surface of a heated drying cylinder with a fabric to preserve the bulk of about 8 cubic centimeter per gram or greater; and,

(e) drying the dewatered wet web to a final dryness.

3. A method for making a cellulosic web, comprising:

(a) depositing an aqueous suspension of papermaking fibers between an endless first fabric and an endless second fabric to form a wet web wherein the wet web is

sandwiched between the first and second fabrics;

(b) passing the wet web sandwiched between the first and second fabrics between an air plenum and a collection device with the second fabric disposed between the wet web and the collection device, the air plenum and collection device being operatively associated and adapted to create a pressure differential across the wet web of about 30 inches of mercury or greater and a stream of pressurized fluid through the wet web of about 10 standard cubic feet per minute per square inch or greater;

(c) dewatering the wet web using the stream of pressurized fluid to a consistency of about 30 percent or greater;

(d) pressing the dewatered wet web against the surface of a heated drying cylinder with the second fabric; and

(e) drying the dewatered wet web to a final dryness.

4. The method of claim 1, wherein the noncompressive dewatering device increases the consistency of the wet web by from about 5 to about 20 percent.

5. The method of claim 2, wherein the wet web is supplementally dewatered to a consistency of about 32 percent or greater.

6. The method of claim 5, wherein the wet web is supplementally dewatered to a consistency of about 34 percent or greater.

7. The method of claim 1, 2, or 3, wherein the pressure differential across the wet web is about 30 inches of mercury or greater.

8. The method of claim 7, wherein the pressure differential across the wet web is from about 35 to about 60 inches of mercury.

9. The method of claim 1, 2, or 3, wherein the pressurized fluid is pressurized to about 5 to about 30 pounds per square inch gauge.

10. The method of claim 1 or 2, wherein the collection device comprises a vacuum box

that draws a vacuum of greater than 0 to about 25 inches of mercury.

11. The method of claim 2 or 3, wherein the dwell time in the air press is about 10 milliseconds or less.

12. The method of claim 11, wherein the dwell time in the air press is about 7.5 milliseconds or less.

13. The method of claim 2 or 3, wherein the wet web is traveling at a speed of about 1000 feet per minute or greater and the consistency of the wet web from entering to exiting the air press increases by about 5 percentage points or more.

14. The method of claim 2 or 3, wherein the wet web is traveling at a speed of about 2000 feet per minute or greater and the consistency of the wet web from entering to exiting the air press increases by about 5 percentage points or more.

15. The method of claim 1 or 2, wherein the wet web is traveling at a speed of about 2000 feet per minute or greater.

16. The method of claim 2 or 3, wherein about 85 percent or greater of the pressurized fluid fed to the air plenum flows through the wet web.

17. The method of claim 16, wherein about 90 percent or greater of the pressurized fluid fed to the air plenum flows through the wet web.

18. The method of claim 1, 2, or 3, wherein the temperature of the pressurized fluid is about 300 degrees Celsius or less.

19. The method of claim 18, wherein the temperature of the pressurized fluid is about 150 degrees Celsius or less.

20. The method of claim 2 or 3, wherein the heated drying cylinder includes a dryer hood and the second fabric that is pressed against the drying cylinder separates from the dryer hood prior to the dewatered wet web entering the dryer hood.

21. The method of claim 2 or 3, wherein the second fabric that is pressed against the drying cylinder wraps the drying cylinder for less than the full distance that the dewatered wet web is in contact with the drying cylinder.

22. The method of claim 1, 2, or 3, wherein the dewatered wet web is transferred to the heated drying cylinder using a pair of transfer rolls that form an extended wrap for a predetermined span.

23. The method of claim 22, wherein one or both of the transfer rolls are not loaded against the heated drying cylinder.

24. The method of claim 22, wherein one or both of the transfer rolls are loaded against the heated drying cylinder.

25. The method of claim 1 or 2, wherein the dewatered wet web is pressed against the drying cylinder with a pressing pressure of about 350 pounds per lineal inch or less.

26. The method of claim 2 or 3, wherein a release agent is added to the second fabric that is pressed against the heated drying cylinder to facilitate the transfer of the dewatered wet web.

27. The method of claim 1 or 2, wherein the flow of pressurized fluid transfers the dewatered wet web to the second fabric.

28. The method of claim 2 or 3, wherein the dewatered wet web is removed from the heated drying cylinder without creping.

29. The method of claim 1, 2, or 3, wherein the dewatered wet web is dried to about 95 percent consistency or more and thereafter creped.

30. The method of claim 1, 2, or 3, wherein the dewatered wet web is partially dried to a consistency of from about 40 to about 80 percent on the surface of the heated drying cylinder, wet creped, and thereafter final dried to a consistency of about 95 percent or greater.

31. An absorbent tissue sheet made by the method of claims 1, 2, or 3.

32. The method of claim 1 or 2, further comprising transferring the wet web to the second fabric and sandwiching the wet web between the second fabric and a support fabric before using the noncompressive dewatering device.

33. The method of claim 1, 2, or 3, wherein the apparatus is a modified crescent-former tissue machine.

34. The method of claim 1, 2, or 3, wherein the second fabric replaces a felt fabric on a crescent-former tissue machine.

35. The method of claim 1, 2, or 3, wherein the air plenum is located within the circuit of the endless second fabric.

36. The method of claim 1 or 2, wherein the air plenum is located within the circuit of the support fabric.

37. The method of claim 3, wherein the air plenum is located within the circuit of the endless first fabric.

38. The method of claim 1, 2, or 3, wherein the vacuum shoe transfers the dewatered wet web to the second fabric prior to transfer of the dewatered wet web to the heated

drying cylinder.

39. The method of claim 1, 2, or 3, wherein the first fabric is a forming fabric.

40. The method of claim 1, 2, or 3, wherein the second fabric is a molding fabric.

41. The method of claim 1, wherein the noncompressive dewatering device is comprised of an air plenum and a collection device.

42. The method of claim 2, 3, or 41, further comprising positioning cross-machine direction sealing members to deflect the course of travel of the wet web and the first and second fabrics toward the collection device.

43. The method of claim 42, wherein the minimum amount of impingement of the cross-machine direction sealing members into the support fabrics is defined by the

equation: $$h(\min) = \frac{T}{W}\left(\cosh\left(\frac{Wd}{T}\right) - 1\right);$$

where: "T" is the tension of the first and second fabrics measured in pounds per inch; "W" is a pressure differential across the web measured in pounds per square inch; and "d" is a gap between a sealing blade and the collection device in the machine direction measured in inches.

44. The method of claim 1, 2, or 3, further comprising configuring the second fabric to provide an unsupported sheet wrap angle of the dewatered wet web about a pressure roll of less than 90 degrees.

45. The method of claim 44, wherein the unsupported sheet wrap angle of the dewatered wet web about a pressure roll is less than 45 degrees.

46. The method of claim 44, wherein the unsupported sheet wrap angle of the

dewatered wet web about a pressure roll is less than 10 degrees.

47. A method of modifying a conventional crescent-former tissue machine having at least one felt and compressive dewatering devices, comprising:

(a) replacing at least one felt with at least one fabric; and,

(b) replacing compressive dewatering devices with non-thermal, noncompressive dewatering devices.

48. The method of claim 47, wherein the fabric is from the group consisting of first fabric, second fabric, support fabric, and combinations thereof.

49. The method of claim 47, wherein at least two felts are replaced with a first fabric and a second fabric.

50. The method of claim 47, wherein at least two felts are replaced with a first fabric and a support fabric.

51. The method of claim 47, wherein at least two felts are replaced with a second fabric and a support fabric.

52. The method of claim 47, wherein at least two felts are replaced with a first fabric and a support fabric.

53. The method of claim 47, wherein the non-thermal noncompressive dewatering device is selected from the group consisting of vacuum box, air press, non-thermal noncompressive pressure roll, and combinations thereof.